JOURNAL OF APPLIED BEHAVIOR ANALYSIS 2003, **36,** 35–46 NUMBER 1 (SPRING 2003)

PROGRESSING FROM PROGRAMMATIC TO DISCOVERY RESEARCH: A CASE EXAMPLE WITH THE OVERJUSTIFICATION EFFECT

HENRY S. ROANE

MARCUS AND KENNEDY KRIEGER INSTITUTES AND
EMORY UNIVERSITY SCHOOL OF MEDICINE

WAYNE W. FISHER

MARCUS AND KENNEDY KRIEGER INSTITUTES AND
JOHNS HOPKINS UNIVERSITY SCHOOL OF MEDICINE

AND

ERIN M. MCDONOUGH

MARCUS INSTITUTE

Scientific research progresses along planned (programmatic research) and unplanned (discovery research) paths. In the current investigation, we attempted to conduct a single-case evaluation of the overjustification effect (i.e., programmatic research). Results of the initial analysis were contrary to the overjustification hypothesis in that removal of the reward contingency produced an increase in responding. Based on this unexpected finding, we conducted subsequent analyses to further evaluate the mechanisms underlying these results (i.e., discovery research). Results of the additional analyses suggested that the reward contingency functioned as punishment (because the participant preferred the task to the rewards) and that withdrawal of the contingency produced punishment contrast.

DESCRIPTORS: autism, behavioral contrast, discovery research, overjustification, punishment

Progress in scientific research often advances on two different paths. Sometimes a researcher follows a planned line of research in which specific hypotheses are tested (referred to as *programmatic research*; Mace, 1994). At other times, unplanned events or serendipitous findings occur that are interesting or noteworthy and that lead the researcher in a previously unforeseen direction (referred to as *discovery research*; Skinner, 1956). The current investigation started as a planned within-subject analysis of the phenomenon referred to as the *overjustification effect* (programmatic research), but when the results were in direct opposition to the overjustification hypothesis, we undertook a different set of analyses in an attempt to understand this serendipitous finding (discovery research). In the remainder of the introduction, we review the relevant literature that led to our initial analysis of the overjustification effect and then review studies relevant to discovery research.

The overjustification hypothesis, which is an often-cited criticism of reward-based programs, states that the delivery of extrinsic rewards decreases an individual's intrinsic interest in the behavior that produced the re-

We thank Kate Gutshall for her assistance in data collection as well as other aspects of this investigation. This investigation was supported in part by Grant MCJ249149-02 from the Maternal and Child Health Service and Grant 5 R01 HD37837-03 from the National Institute of Child Health and Human Development within the U.S. Department of Health and Human Services.

Requests for reprints should be sent to Henry S. Roane, Marcus Institute, 1920 Briarcliff Road, Atlanta, Georgia 30329.

wards (Greene & Lepper, 1974). For example, an individual may play guitar simply because it is a preferred activity. If the individual is subsequently paid for playing the guitar, the overjustification hypothesis predicts that guitar playing will decrease when payment is no longer received. From a general cognitive perspective, the use of the external reward may devalue the intrinsic interest in the behavior in that the individual changes the concept of why he or she is engaging in the response and interprets the behavior as "work" rather than "pleasure" (see Deci, 1971, for a more detailed discussion of this interpretation).

It should be noted that the overjustification hypothesis does not predict what effect the use of rewards will have on the target response (i.e., whether those rewards will function as reinforcement and increase the future probability of the response). In addition, the nontechnical term *reward* is used to describe a preferred stimulus that is presented contingent on a response with the goal of increasing the future occurrence of that response. By contrast, the term *positive reinforcement* is reserved for conditions in which contingent presentation of a stimulus actually produces an increase in the future probability of the target response. Unfortunately, most studies on the overjustification effect have been conducted using between-groups designs and arbitrarily determined rewards (Reitman, 1998), which do not allow a proper evaluation of whether the stimuli functioned as positive reinforcers (rather than so-called rewards).

Several investigations have been conducted to evaluate the validity of the overjustification hypothesis and have produced mixed results. Deci (1971), for example, showed evidence of overjustification by comparing the puzzle completion of two groups of participants. Following baseline observation, one group received a $1 reward for puzzle completion and the other group did not. For the reward group, puzzle completion decreased below the initial baseline level following cessation of the reward contingency, whereas stable levels of completion were observed for the control group. Greene and Lepper (1974) compared levels of coloring across three groups of children and found that children who received a reward for coloring showed less interest in coloring once the reward contingency was removed relative to children who were never told that they would receive a reward.

By contrast, Vasta and Stirpe (1979) showed evidence that did not support the overjustification hypothesis. First, baseline data were collected on worksheet completion for two groups of children. Following baseline, token delivery was initiated with one group. This resulted in an increase in the target response; however, participants in the experimental group returned to their initial response levels during the reversal to baseline. That is, no evidence of the overjustification effect was obtained.

From a behavior-analytic perspective, the overjustification effect might be conceptualized as behavioral contrast (Balsam & Bondy, 1983). Behavioral contrast involves an interaction between two schedules in which manipulation of one schedule produces an inverse (or contrasting) change in the response associated with the unchanged schedule (e.g., introduction of extinction for Response A not only decreases Response A but also increases Response B). Behavioral contrast has been reported most frequently for schedule interactions that occur during multiple and concurrent schedules (Catania, 1992; Reynolds, 1961), but contrast effects can sometimes occur across successive phases with a single response (Azrin & Holz, 1966).

The overjustification effect, when it occurs, is an example of successive behavioral contrast in which a schedule change in one phase affects the level of a single response in a subsequent phase. That is, during the ini-

tial baseline, the target response is presumably maintained by automatic reinforcement (e.g., playing guitar 1 hr per day). Following introduction of the external reward (e.g., payment for playing guitar), any increase in responding (e.g., playing guitar 2 hr per day) would be attributable to the reinforcement effect of the reward. If withdrawal of the external reward decreases responding below the levels in the initial baseline (e.g., playing guitar 1 hr every 2 days), the difference in responding between the two baseline phases (i.e., the one preceding and the one following the reinforcement phase) would represent a contrast (or overjustification) effect. Negative behavioral contrast has been defined as response suppression for one reinforcer following prior exposure to a more favorable reinforcer (Mackintosh, 1974). In the above example, the decrease in responding during the second baseline phase would be attributable to the prior increase in reinforcement (i.e., automatic reinforcement plus payment) and would represent negative behavioral contrast. Interpreting overjustification as negative behavioral contrast may be a more parsimonious interpretation of the effect, as opposed to cognitive perspectives, because of the observability of the response under question across successive phases. In addition, interpreting the overjustification effect as behavioral contrast may help to explain why prior research on this phenomenon has produced such mixed results, in that contrast effects tend to be transient and inconsistent phenomena (Balsam & Bondy, 1983; Eisenberger & Cameron, 1996).

Although programmatic lines of research often lead to scientific advances, in many cases serendipitous findings may also lead to new areas of research. Many of Skinner's early discoveries were the result of unplanned findings in his laboratory. For example, the production of an extinction curve was due to equipment failure (i.e., a jam in the food magazine), intermittent reinforcement schedules were developed based on the need to conserve food pellets, and the development of the fixed-ratio schedule occurred within the context of controlling for deprivation under fixed-interval schedules (Skinner, 1956). In addition, many research programs have been developed based on unexpected or accidental findings in the laboratory (see Brady, 1958). Unplanned results are important to researchers because such findings often produce a line of "curiosity-testing" research in which novel scientific findings are obtained (Sidman, 1960).

In the current investigation, we describe a case example in which a planned line of programmatic research (i.e., a single-case evaluation of the overjustification hypothesis) produced unexpected results. Based on these results, additional analyses were conducted to evaluate the mechanisms underlying these findings.

GENERAL METHOD

Participant and Setting

Arnold, a 14-year-old boy who had been diagnosed with autism, cerebral palsy, moderate mental retardation, and visual impairments, had been admitted to an intensive day-treatment program for the assessment and treatment of self-injurious behavior (head banging). He had a vocabulary of approximately 1,000 words and was able to follow multiple-step instructions to complete complex tasks (e.g., folding laundry, operating a dishwasher) but required some assistance with self-help skills (e.g., dressing, ambulating long distances) due primarily to his visual impairment. Throughout this investigation, Arnold received constant dosages of fluvoxamine, divalproex, and olanzapine.

All sessions were conducted in a padded room (approximately 4 m by 3 m) that contained chairs, a table, and other stimuli (e.g., toys, work materials) needed for the condi-

tion in effect. A therapist was present in the room with Arnold across all conditions, and one or two observers were seated in unobtrusive locations in the room.

Response Measurement and Reliability

Observers collected data on sorting (in the reward and time-out analyses), in-seat behavior (in the reinforcer assessment and the reward analysis), and orienting behavior (in the time-out analysis). *Sorting* was defined as placing a piece of silverware in a plastic utensil tray that was divided into different spaces, each shaped like a particular type of silverware (i.e., knife, fork, or spoon). Sorting was scored only when Arnold placed a piece of silverware in the correct space in the tray. Sorting was identified as the target behavior based on reports from home and school that this was a task that Arnold completed independently. *In-seat behavior* was defined as contact of the buttocks to the seat of a chair. *Orienting behavior* consisted of responses that were necessary for an individual with visual impairments to locate the task materials and included touching areas of the table until the tray was located or touching the various utensil spaces on the tray. For the purpose of data analysis, sorting was recorded as a frequency measure and was converted to responses per minute. Durations of in-seat behavior and orienting behavior were converted to percentage of session time by dividing the duration of the behavior by the duration of the session (i.e., 600 s of work time) and multiplying by 100%.

A second observer independently collected data on 46.3% of all sessions. Exact agreement was calculated by comparing observer agreement on the exact number (or duration) of occurrences or nonoccurrences of a response during each 10-s interval. The agreement coefficient was computed by dividing the number of exact agreements on the occurrence or nonoccurrence of behavior by the number of agreements plus disagreements and multiplying by 100%. Agreement on sorting averaged 86.6% (range, 78.7% to 98.3%) in the reward analysis and 88.4% (range, 81.9% to 92.6%) in the time-out analysis. Agreement on in-seat behavior averaged 96.8% (range, 90.3% to 100%) in reward analysis and 98.9% (range, 96.8% to 100%) in the reinforcer assessment. Agreement on orienting behavior averaged 88.1% (range, 85.2% to 91.1%) in the time-out analysis.

Experiment 1: Reward Analysis

Method

Preference assessment. A modified stimulus-choice preference assessment was conducted to identify a hierarchy of preferred stimuli (Fisher et al., 1992; Paclawskyj & Vollmer, 1995). Stimuli included in this assessment were based on informal observations of Arnold's interactions with various stimuli and on caregiver report of preferred items (Fisher, Piazza, Bowman, & Amari, 1996). Eight stimuli were included in the preference assessment, and each stimulus was paired once with every other stimulus in a random order. At the beginning of each presentation, the therapist (a) held a pair of stimuli in front of Arnold, (b) vocally told Arnold which item was located to the left and which was to the right, (c) guided Arnold to touch and interact with each item for approximately 5 s, and (d) said, "Pick one." Contingent on a selection, Arnold received access to the item for 20 s. After the 20-s interval elapsed, the stimulus was withdrawn, and two different stimuli were presented in the same manner. Simultaneous approaches toward both stimuli were blocked, and the items were briefly withdrawn and re-presented in the manner described above.

Reward analysis. This analysis consisted of two conditions, baseline and contingent reward. During baseline, Arnold was seated at

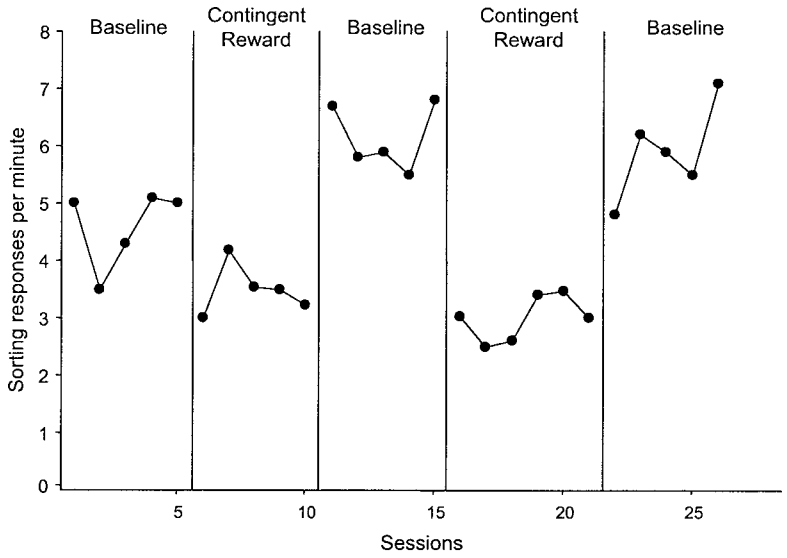

Figure 1. Sorting responses per minute during the reward analysis.

a table with a box of silverware located on the floor to the left of his chair. A plastic tray was located approximately 25 cm from the edge of the table (the location was marked by a piece of tape). Throughout the session, Arnold was prompted to engage in the target behavior (i.e., the therapist said "Arnold, sort the silverware") on a fixed-time (FT) 60-s schedule. No differential consequences were arranged for the emission of the sorting response, and all other behavior was ignored. In the contingent reward condition, Arnold received 20-s access to the two preferred stimuli (toy telephone and radio) for sorting silverware on a fixed-ratio (FR) 1 schedule. When Arnold gained access to the preferred stimuli, the tray and the box of silverware were removed, and the preferred stimuli were placed on the table. After the 20-s interval elapsed, the preferred stimuli were removed, the tray and the box of silverware were returned to their initial positions, and Arnold could resume sorting. With the exception of the presentation of preferred stimuli, the contingent reward condition was identical to the baseline condition (i.e., silverware and tray were present, prompts were delivered on an FT 60-s schedule, and all other behavior was ignored).

The baseline and contingent reward conditions were alternated in a reversal (ABABA) design. All sessions consisted of 10 min of work time (i.e., the session clock stopped during each 20-s interval in which preferred stimuli were delivered).

Results and Discussion

Preference assessment. Two stimuli were chosen on over 80% of presentations during the stimulus-choice preference assessment. A toy telephone was chosen on 100% of presentations and a radio was chosen on 86% of presentations.

Reward analysis. This analysis was conducted to determine if contingent presentation of preferred toys would increase the target response while the contingency was in effect and then decrease this response below its initial baseline levels once the contingency was withdrawn (i.e., would produce negative behavioral contrast or an overjustification effect). Results of the reward analysis are shown in Figure 1. The initial baseline resulted in moderately high levels of sorting (M = 4.6 responses per minute). Contrary

to expectations, contingent access to preferred toys actually decreased the rate of sorting ($M = 3.5$). A reversal to the baseline condition showed that sorting increased to levels that exceeded the initial baseline ($M = 6.1$). Subsequent introduction of the toys produced another decrease in sorting ($M = 3.6$) that was followed by a recovery of increased sorting rates in the second reversal to the baseline condition ($M = 5.9$). In summary, contingent presentation of the preferred toys decreased responding relative to its initial baseline levels, and removal of the contingency produced increased response rates that exceeded initial baseline levels.

Because the reward contingency decreased responding while it was in effect and increased responding above the initial baseline levels after it was withdrawn (in direct opposition to the prediction of the overjustification hypothesis), subsequent analyses were conducted to evaluate several potential explanations of the observed effects of the contingency. One potential explanation was that contingent access to the preferred stimuli functioned as punishment (time-out from the automatic reinforcement produced by sorting) because the delivery of the preferred toys interrupted an even more preferred activity (sorting the silverware). A second potential explanation of the effects of the contingency was that presentation of the preferred stimuli increased the complexity of the task because the participant was visually impaired and had to reorient to the sorting materials after each delivery of the preferred stimuli. To evaluate these possibilities, we conducted an additional analysis. The second (time-out) analysis was a direct test of the effects of time-out from the sorting task, while the duration of orienting behaviors was measured (to determine whether the reductions in sorting were attributable to the increased complexity resulting from these prerequisite responses). If time-out produced reductions in silverware sorting similar to those produced during the contingent reward condition, it would strongly suggest that contingent access to toys functioned as punishment for silverware sorting and the subsequent increases resulted from behavioral contrast. Alternatively, high levels of orienting behavior in the time-out condition would suggest that the results obtained in the reward analysis were due to increased task complexity.

Experiment 2: Time-out Analysis

Method

The baseline condition was identical to the one conducted in the reward analysis (i.e., silverware located to the left of the chair, a tray present on the table, and prompts delivered every 60 s). The time-out condition was identical to baseline except that the tray and box of silverware were removed for 20 s contingent on the sorting response on an FR 1 schedule. Thus, this condition was similar to the contingent reward condition of the reward analysis except that the preferred stimuli were not delivered following each sorting response. At the end of the 20-s time-out, the therapist returned the tray and box of silverware and Arnold could resume sorting. All other responses were ignored. The baseline and time-out conditions were compared in a multielement design. All sessions consisted of 10 min of work time (i.e., the session clock stopped during each 20-s time-out interval).

Results and Discussion

Results of the time-out analysis are presented in Figure 2. Rates of sorting ($M = 6.4$ responses per minute) during baseline were similar to the rates observed during the last two baseline phases of the reward analysis. Lower rates of sorting were observed in the time-out condition ($M = 3.4$). This rate is similar to the rates observed in the contingent reward phases of the reward analysis.

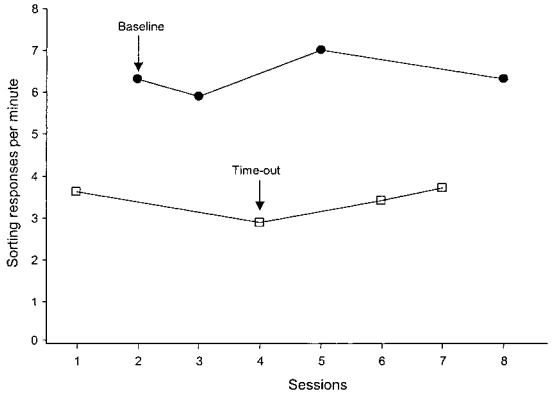

Figure 2. Sorting responses per minute during the time-out analysis.

Given Arnold's visual impairments, it was possible that the lower rates observed during the time-out condition could be due to orienting responses that may have been needed to reinitiate the sorting response after each time-out interval (i.e., orienting the materials prior to working). Thus, during the time-out condition, observers collected data on the time Arnold allocated to such orienting responses. These data revealed that the differences between the amount of time Arnold allocated to orienting responses during baseline (M = 0.6 s per session) and the time-out conditions (M = 2.4 s per session) were negligible and could not account for the observed reductions in the sorting response.

Results of the time-out analysis suggested that interruption of the ongoing sorting response functioned as punishment and reduced the occurrence of sorting. Thus, it was likely that the results obtained in the reward analysis were attributable to the interruption of the sorting response via the contingent presentation of the preferred toys. Also, results of the reward and time-out analyses suggested that sorting was a highly preferred response, which was possibly more preferred than playing with the toy telephone and radio. To examine this possibility, a third analysis was conducted to evaluate the relative reinforcing efficacy of the preferred toys when no alternative stimulation was available and when Arnold had a choice between the preferred toys and sorting silverware.

Experiment 3: Reinforcer Assessments

Method

A reinforcer assessment (based on Roane, Vollmer, Ringdahl, & Marcus, 1998) was conducted to evaluate the reinforcing effects of the preferred stimuli when no alternative stimulation was available (Phase 1) and when Arnold had a choice between the preferred stimuli and the sorting response (Phase 2). During each phase of the assessment, two chairs were concurrently available in the room. During Phase 1, sitting in one chair produced continuous access to the toy telephone and radio (the preferred stimuli identified during the preference assessment), whereas sitting in the other chair produced no consequence (control chair). During Phase 2, sitting in one chair produced continuous access to the toy telephone and radio, whereas sitting in the other chair produced continuous access to the sorting task. Prior to each session, Arnold was guided to sit in each chair, and he received the consequence associated with that chair. At the beginning of the session, Arnold was moved 1.5 m from the chairs, was told which chair was located to his left and right, and was prompted to select one of the chairs. After 5 min elapsed, the session clock was paused and Arnold was guided to stand up and walk to the starting area (i.e., 1.5 m from the chairs). At this point the chairs and their respective contingencies were reversed (e.g., the reinforcement chair became the control chair and vice versa). Arnold was again prompted to choose a chair, the session clock resumed, and the session continued as described above.

Results

Results of the reinforcer assessment are shown in Figure 3. In Phase 1, when sitting

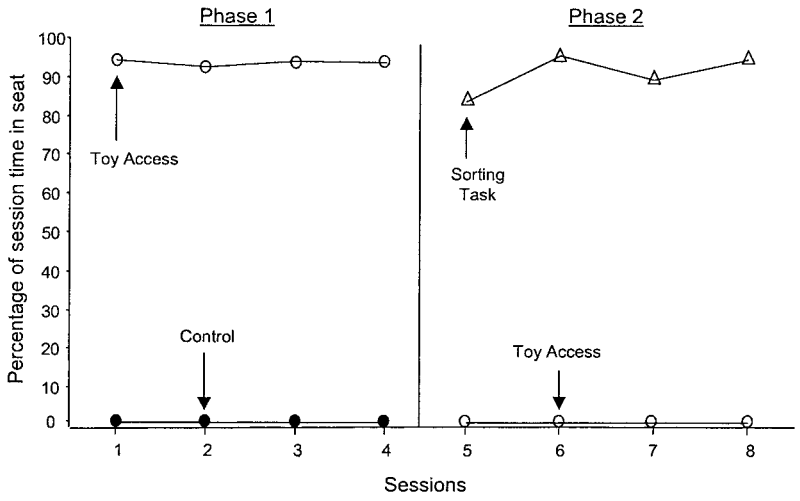

Figure 3. Percentage of session time of in-seat behavior during reinforcer assessment.

in one chair produced continuous access to the preferred toys and sitting in the other chair produced no consequence, Arnold allocated all of his responding toward the chair associated with the toys (M = 94.1% of the session time) to the exclusion of the control chair. By contrast, in Phase 2, when one chair produced continuous access to these same preferred toys but the other chair produced continuous access to the sorting task, Arnold allocated all of his responding to the chair associated with the sorting materials (M = 92.3% of the session time) to the exclusion of the chair associated with preferred stimuli. These results indicate that the preferred toys functioned as reinforcement for in-seat behavior when the alternative was no stimulation but not when the alternative was engagement in the sorting task. Arnold clearly preferred the sorting task to the toys.

GENERAL DISCUSSION

In the current investigation, a young man sorted silverware in the absence of external reward delivery. This behavior met the definition of intrinsically motivated behavior described by Deci (1971). The overjustification hypothesis states that levels of an intrinsically motivated behavior will decrease to levels below the prereward baseline following cessation of the reward contingency. Not only was this effect not evident in the current investigation, but the results were directly opposite of the prediction of the overjustification hypothesis.

Results of the initial (reward) analysis revealed what might be termed an *antioverjustification* effect in that (a) contingent presentation of high-preference stimuli resulted in a decrease in responding relative to baseline and (b) responding *increased* when the behavior no longer produced the external reward. The unexpected results of the initial analysis led to the development of additional hypotheses that were evaluated through subsequent analyses. These additional analyses suggested that interruption of the sorting task (via the removal of sorting materials) functioned as punishment and that the sorting task was a more preferred response relative to toy play.

Two operant mechanisms appear to provide the most parsimonious accounts for the results observed in the current investigation. Results of the reward and time-out analyses suggest that decreased response levels were attributable to the removal of the sorting

materials, which interrupted the ongoing sorting response. Contingent interruption of automatically reinforced behavior has been used to reduce the occurrence of such responses and has been reported as a punishment effect (e.g., Barmann, Croyle-Barmann, & McLain, 1980; Lerman & Iwata, 1996). Likewise, interruption of the sorting task appeared to function as punishment. The removal of the response manipulanda in the reward and time-out analyses is similar to the time-out procedures used in laboratory research. Ferster and Skinner (1957) defined time-out as "any period of time during which the organism is prevented from emitting the behavior under observation" (p. 34). Time-out periods frequently result in a decreased rate of responding (Ferster & Skinner). In the current investigation, Arnold could not emit the target response (sorting) during the reward interval of the reward analysis or during the time-out interval of the time-out analysis because access to the silverware and tray was restricted. Thus, it appears that the decrease in behavior during the contingent reward and time-out conditions was due to punishment in the form of time-out from the more preferred reinforcer (the sorting task).

The second general effect observed in the current investigation (i.e., increases in responding relative to the initial baseline) is indicative of behavioral contrast. Specifically, a contrast effect was noted in that responding increased following prior exposure to a less preferred consequence (i.e., interruption). Recall that the overjustification hypothesis may be interpreted as negative behavioral contrast (i.e., responding for one reinforcer decreases following exposure to a more preferred reinforcer). By contrast, in the current investigation the target behavior decreased initially and increased in the subsequent baseline phases.

Given that the behavior decreased during the contingent reward and time-out conditions, it is not appropriate to conceptualize the current results as reinforcement contrast. The current results appear to be more accurately characterized as an example of punishment contrast (i.e., increase in responding for a reinforcer following exposure to punishment). Ferster and Skinner (1957) found higher rates of responding following a time-out period relative to the levels of responding observed prior to the time-out. Similarly, Azrin (1960) showed that responding following the cessation of a punishment contingency increased to levels that exceeded prepunishment baseline levels.

Although the mechanism underlying punishment contrast remains uncertain, it seems that increases in responding following a punishment contingency may be related to decreased amounts of reinforcement during the punishment phase. In other words, punishment may create a deprivation state that results in an increase in responding in a subsequent (nonpunishment) phase (Azrin & Holz, 1966), an interpretation that is also consistent with the response-deprivation hypothesis (Timberlake & Allison, 1974; for more in-depth reviews of this and other potential explanations of punishment contrast, see Azrin & Holz or Crosbie, Williams, Lattal, Anderson, & Brown, 1997).

An alternative to the punishment contrast explanation is that the decrease in the target response observed during the contingent reward and time-out conditions may have been due to disrupted response momentum (Nevin, 1996). Specifically, presentation of the toys and removal of the sorting materials may have functioned to disrupt the ongoing high-probability sorting response, such that response levels dropped relative to the nondisrupted baseline. However, if the decrease in the target response observed during the contingent reward phase were due to disrupted response momentum, one would not expect responding to increase in the second baseline to levels above those observed dur-

ing the initial baseline. To the contrary, if the response's momentum were disrupted, one would expect lower levels of responding during the second baseline relative to the first.

One potentially important aspect of the current results is that they illustrate the relative nature of reinforcement, and of punishment for that matter (Herrnstein & Loveland, 1975; Premack, 1971; Timberlake & Allison, 1974). Typically, stimuli identified as highly preferred in stimulus preference assessments function as effective positive reinforcers (e.g., Fisher et al., 1992; Roane et al., 1998). In the current investigation, contingent access to the toy telephone and radio (the items identified as highly preferred during the preference assessment) did not function as reinforcement for the sorting response during the reward analysis. Results of the reinforcer assessment helped to explain this finding by showing that these stimuli (the toys) functioned as reinforcement (for in-seat behavior) when the alternative was sitting in a chair associated with no alternative reinforcement but not when the choice was between the toys and the sorting task.

In light of the results of the reinforcer assessment, it is not surprising that a reinforcement effect was not obtained in the reward analysis. In fact, if the reinforcer assessment had been conducted first, the results of the reward analysis could have been predicted using either the probability-differential hypothesis (i.e., the Premack principle; Premack, 1959) or the response-deprivation hypothesis (Timberlake & Allison, 1974). The probability-differential hypothesis states that a higher probability response will increase the occurrence of a lower probability response, if the contingency is arranged such that the high-probability response is contingent on the low-probability response. In the current investigation, the probability-differential hypothesis would predict that contingent access to the toys would function as punishment for the sorting response because a lower probability response was presented contingent on a higher probability response (Premack, 1971). The response-deprivation hypothesis states that restricting a response below its free-operant baseline probability will establish its effectiveness as reinforcement for another response. Response deprivation would predict the absence of a reinforcement effect (but not necessarily a punishment effect), because playing with the toys did not occur when this response and the sorting response were concurrently available. Under this condition, it was not possible to produce response deprivation for toy play (which would be necessary to establish its effectiveness as reinforcement according to response-deprivation theory) because the initial probability of toy play was zero (see Konarski, Johnson, Crowell, & Whitman, 1980, for a more complete discussion of the convergent and divergent predictions of the Premack principle and the response-deprivation hypothesis).

Future research should consider the relativity of reinforcement when designing behavioral interventions. Specifically, researchers should consider conducting concurrent arrangements of potential instrumental (e.g., tasks) and contingent (e.g., preferred stimuli) responses in conjunction with either the Premack principle or the response-deprivation hypothesis to help to ensure that a reinforcement contingency will be arranged appropriately.

Additional research should also be directed at extending initial unexpected or negative findings by examining the factors that contribute to such results (e.g., Piazza, Fisher, Hanley, Hilker, & Derby, 1996; Ringdahl, Vollmer, Marcus, & Roane, 1997). In the current investigation, the reward analysis failed to yield the anticipated results. That is, the original purpose of our analysis was to conduct a single-case evaluation of the ov-

erjustification effect using empirically derived preferred stimuli. From this perspective, the initial results could be interpreted as a failure. However, the negative results of the reward analysis led to further experimentation designed to address additional hypotheses. These additional analyses allowed us pursue other research questions (i.e., through discovery research; Skinner, 1956).

Future research should also continue to evaluate the overjustification hypothesis using single-case designs and methods appropriate to the evaluation of contrast effects (Crosbie et al., 1997). In addition, investigators should examine the effects of various types of contrast effects on behavioral interventions. As with other operant principles, contrast mechanisms may vary in terms of their effect on subsequent behavior (i.e., increase or decrease) and the conditions under which they occur (i.e., simultaneous or successive schedules; Mackintosh, 1974). In addition, contrast effects are generally considered to be transient phenomena in that response rates generally return to baseline levels over time (Azrin & Holz, 1966). Finally, future research could help to determine whether the overjustification effect represents an example of a transient negative contrast, which may add perspective regarding the importance of the phenomenon.

REFERENCES

Azrin, N. H. (1960). Effects of punishment intensity during variable-interval reinforcement. *Journal of the Experimental Analysis of Behavior, 3,* 123–142.

Azrin, N. H., & Holz, W. C. (1966). Punishment. In W. K. Honig (Ed.), *Operant behavior: Areas of research and application* (pp. 380–447). New York: Appleton-Century-Crofts.

Balsam, P. D., & Bondy, A. S. (1983). The negative side effects of reward. *Journal of Applied Behavior Analysis, 16,* 283–296.

Barmann, B. C., Croyle-Barmann, C., & McLain, B. (1980). The use of contingent-interrupted music in the treatment of disruptive bus-riding behavior. *Journal of Applied Behavior Analysis, 13,* 693–698.

Brady, J. V. (1958). Ulcers in "executive" monkeys. *Scientific American, 199,* 95–100.

Catania, A. C. (1992). *Learning* (3rd ed.). Englewood Cliffs, NJ: Prentice Hall.

Crosbie, J., Williams, A. M., Lattal, K. A., Anderson, M. M., & Brown, S. M. (1997). Schedule interactions involving punishment with pigeons and humans. *Journal of the Experimental Analysis of Behavior, 68,* 161–175.

Deci, E. L. (1971). Effects of externally mediated rewards on intrinsic motivation. *Journal of Personality and Social Psychology, 18,* 105–115.

Eisenberger, R., & Cameron, J. (1996). Detrimental effects of reward. *American Psychologist, 51,* 1153–1166.

Ferster, C. B., & Skinner, B. F. (1957). *Schedules of reinforcement.* New York: Appleton-Century-Crofts.

Fisher, W. W., Piazza, C. C., Bowman, L. G., & Amari, A. (1996). Integrating caregiver report with a systematic choice assessment to enhance reinforcer identification. *American Journal on Mental Retardation, 101,* 15–25.

Fisher, W., Piazza, C. C., Bowman, L. G., Hagopian, L. P., Owens, J. C., & Slevin, I. (1992). A comparison of two approaches for identifying reinforcers for persons with severe to profound disabilities. *Journal of Applied Behavior Analysis, 25,* 491–498.

Greene, D., & Lepper, M. R. (1974). Effects of extrinsic rewards on children's subsequent intrinsic interest. *Child Development, 45,* 1141–1145.

Herrnstein, R. J., & Loveland, D. H. (1975). Maximizing and matching on concurrent ratio schedules. *Journal of the Experimental Analysis of Behavior, 24,* 107–116.

Konarski, E. A., Jr., Johnson, M. R., Crowell, C. R., & Whitman, T. L. (1980). Response deprivation and reinforcement in applied settings: A preliminary analysis. *Journal of Applied Behavior Analysis, 13,* 595–609.

Lerman, D. C., & Iwata, B. A. (1996). A methodology for distinguishing between extinction and punishment effects associated with response blocking. *Journal of Applied Behavior Analysis, 29,* 231–233.

Mace, F. C. (1994). Basic research needed for stimulating the development of behavioral technologies. *Journal of the Experimental Analysis of Behavior, 61,* 529–550.

Mackintosh, N. J. (1974). *The psychology of animal learning.* London: Academic Press.

Nevin, J. A. (1996). The momentum of compliance. *Journal of Applied Behavior Analysis, 29,* 535–547.

Paclawskyj, T. R., & Vollmer, T. R. (1995). Reinforcer assessment for children with developmental disabilities and visual impairments. *Journal of Applied Behavior Analysis, 28,* 219–224.

Piazza, C. C., Fisher, W. W., Hanley, G. P., Hilker,

K., & Derby, K. M. (1996). A preliminary procedure for predicting the positive and negative effects of reinforcement-based procedures. *Journal of Applied Behavior Analysis, 29,* 137–152.
Premack, D. (1959). Toward empirical behavioral laws: I. Positive reinforcement. *Psychological Review, 66,* 219–233.
Premack, D. (1971). Catching up with common sense or two sides of a generalization: Reinforcement and punishment. In R. Glaser (Ed.), *The nature of reinforcement* (pp. 121–150). New York: Academic Press.
Reitman, D. (1998). The real and imagined harmful effects of rewards: Implications for clinical practice. *Journal of Behavior Therapy and Experimental Psychiatry, 29,* 101–113.
Reynolds, G. S. (1961). Behavioral contrast. *Journal of the Experimental Analysis of Behavior, 4,* 57–71.
Ringdahl, J. E., Vollmer, T. R., Marcus, B. A., & Roane, H. S. (1997). An analogue evaluation of environmental enrichment: The role of stimulus preference. *Journal of Applied Behavior Analysis, 30,* 203–216.
Roane, H. S., Vollmer, T. R., Ringdahl, J. E., & Marcus, B. A. (1998). Evaluation of a brief stimulus preference assessment. *Journal of Applied Behavior Analysis, 31,* 605–620.
Sidman, M. (1960). *Tactics of scientific research: Evaluating experimental data in psychology.* Boston: Authors Cooperative.
Skinner, B. F. (1956). A case history in scientific method. *American Psychologist, 11,* 221–233.
Timberlake, W., & Allison, J. (1974). Response deprivation: An empirical approach to instrumental performance. *Psychological Review, 81,* 146–164.
Vasta, R., & Stirpe, L. A. (1979). Reinforcement effects on three measures of children's interest in math. *Behavior Modification, 3,* 223–244.

Received March 13, 2002
Final acceptance November 14, 2002
Action Editor, Patrick C. Friman

STUDY QUESTIONS

1. What is the overjustification hypothesis? Provide an example that illustrates the predictions of this hypothesis.

2. Briefly describe the procedures used in the reward analysis (Experiment 1) and the results that were obtained.

3. What was the purpose of the time-out analysis in Experiment 2? How was the time-out condition similar to and different from the contingent reward condition of the reward analysis conducted in Experiment 1?

4. What were the results of the time-out analysis, and what do they suggest about the results obtained in the reward analysis?

5. What was the purpose of collecting data on orienting responses during the time-out analysis, and what did these data reveal?

6. Briefly describe the procedures used to assess the reinforcing effects of preferred stimuli in Experiment 3.

7. What were the results of the reinforcer assessment in Experiment 3? How do these results aid in the interpretation of the reward analysis results in Experiment 1?

8. Given the results obtained in the reinforcer assessment (Experiment 3), what additional manipulations might have been undertaken to evaluate the overjustification effect with this participant?

Questions prepared by Claudia Dozier and Carrie Dempsey, The University of Florida